Building a Lean Learning Enterprise: Learning from Toyota

Jeffrey K. Liker

Professor, Industrial and Operations Engineering
The University of Michigan
and Principal, *Optiprise, Inc.*

2004

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Why Learn from Toyota?

- Reached 2000 goal of 10% market share and moving toward 2015 goal of 15%--largest in world
- Consistently profitable--$10 billion on $125 billion in 2002
- Consistent war chest of $30 -$40 billion
- Fastest product development process in auto business
- Consistently among top plants in productivity
- Consistently award winning quality levels
- Has triggered a global transformation of manufacturing to the Toyota Production System aka “Lean Manufacturing.”

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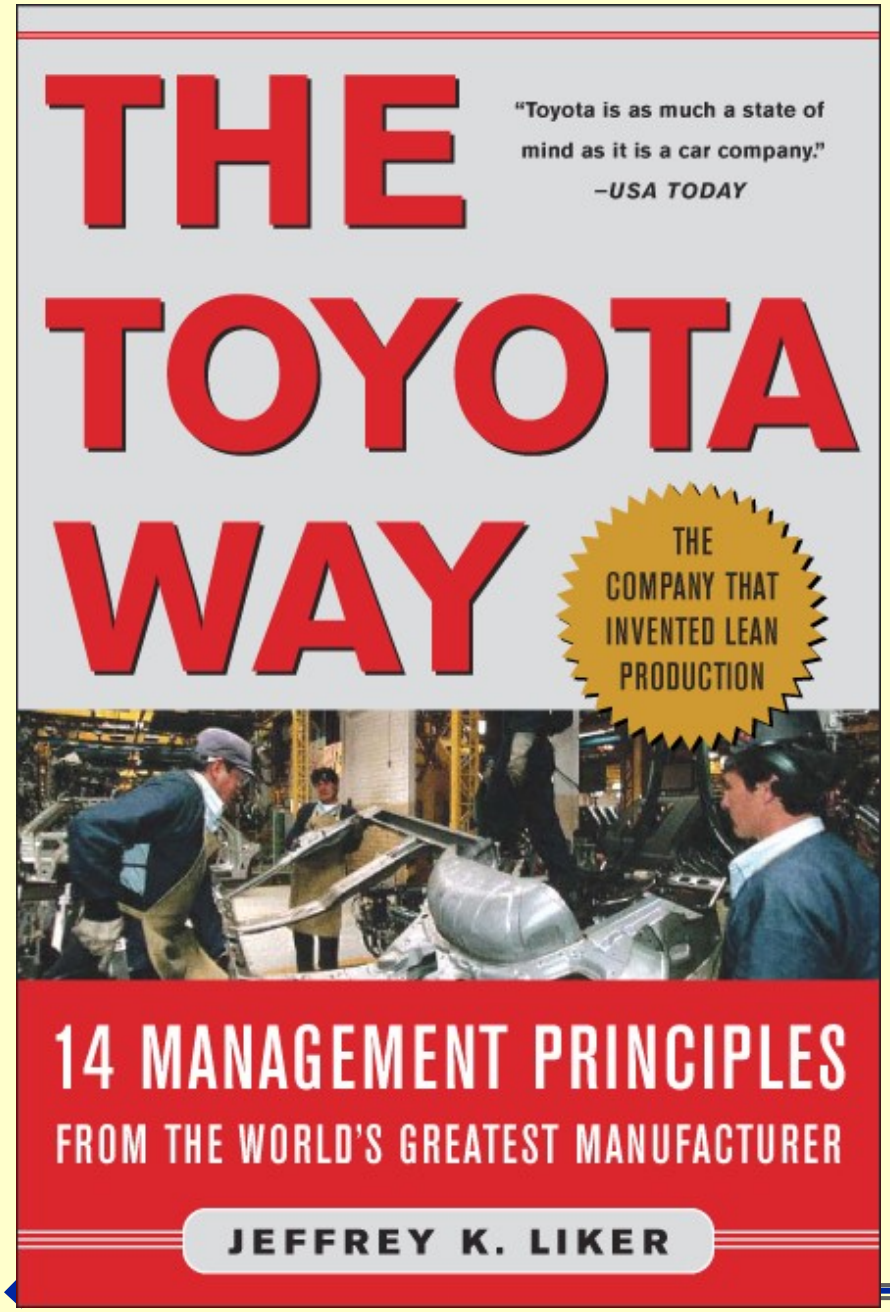
THE TOYOTA WAY
"Toyota is as much a state of mind as it is a car company."
–USA TODAY
THE COMPANY THAT INVENTED LEAN PRODUCTION
14 MANAGEMENT PRINCIPLES
FROM THE WORLD'S GREATEST MANUFACTURER
JEFFREY K. LIKER

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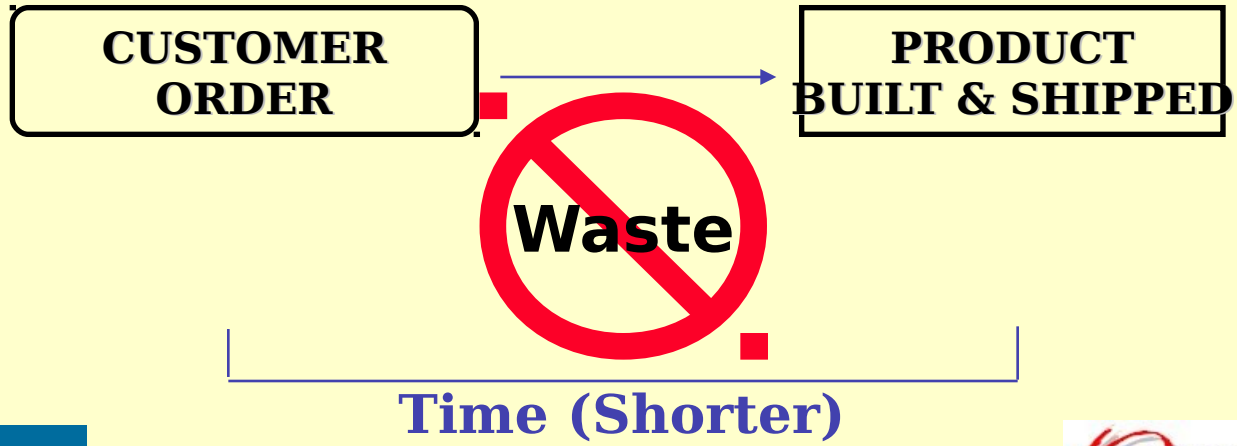
Lean Manufacturing

is a manufacturing philosophy which shortens the time between the customer order and the product build / shipment by eliminating *sources* of waste.

Business as Usual

Lean Manufacturing



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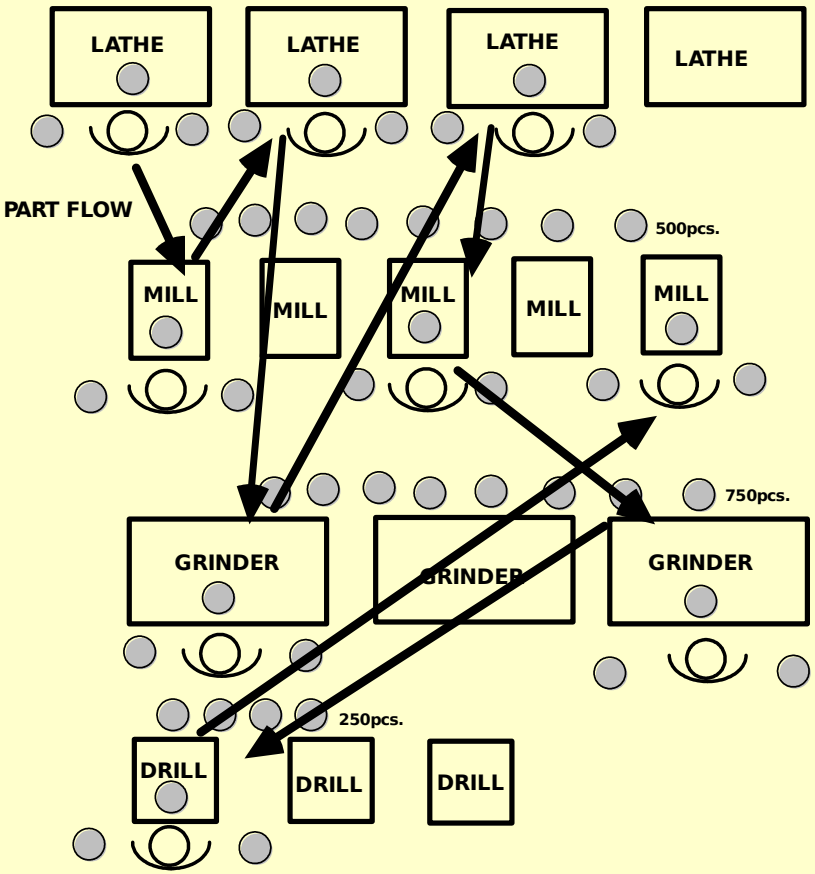
Before Lean: Organization By Machine Type With Convoluted Flow

No Organization and No Control



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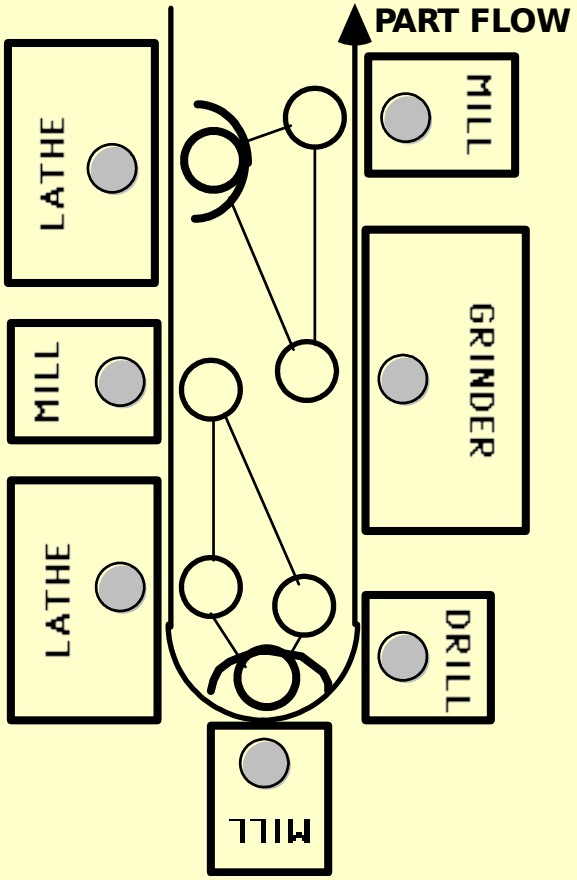
After Lean: U-Shaped One-Piece Flow Cell

Organization and Control



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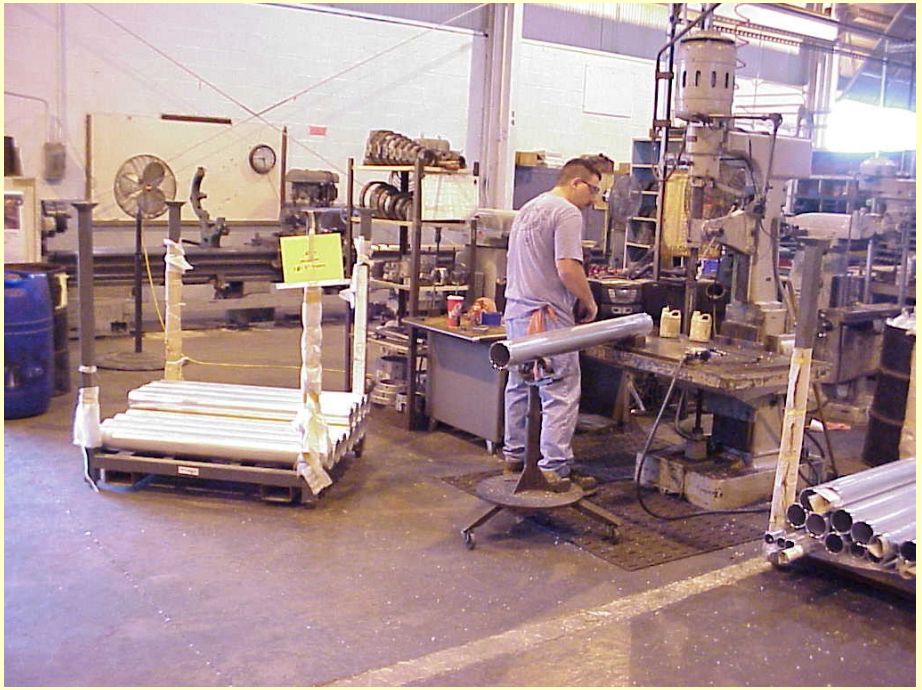
Pre-workshop process

Lathe operation

Drilling operation



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Improvement Opportunities

- Focus on saw, lathe, drill, and weld operations in Mast Production Area
- Eliminate use of forklift between saw, lathe, drill and weld operations
- Eliminate use of Portlands between saw, lathe, drill and weld operations
- Create one-piece flow between saw, lathe, drill and weld operations
- Create dolly to move Portlands by hand between Weld and Buff operations
- Create one shop order per mast, rather than per tube
- Create kanban to delivery components (butt plates) to weld cell

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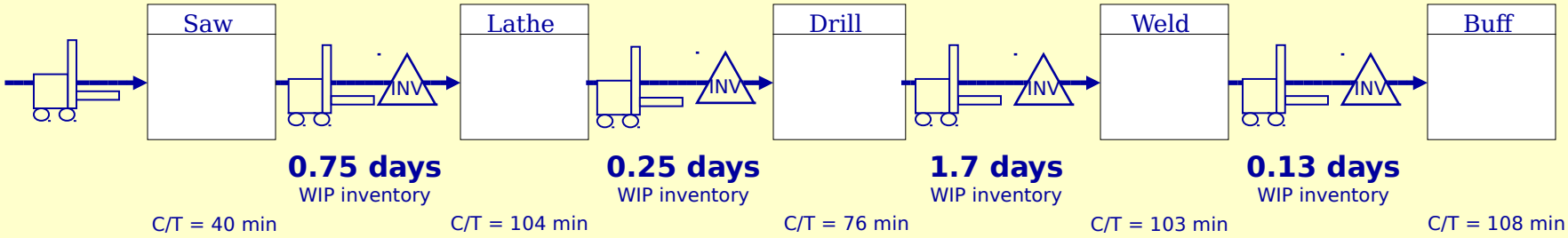
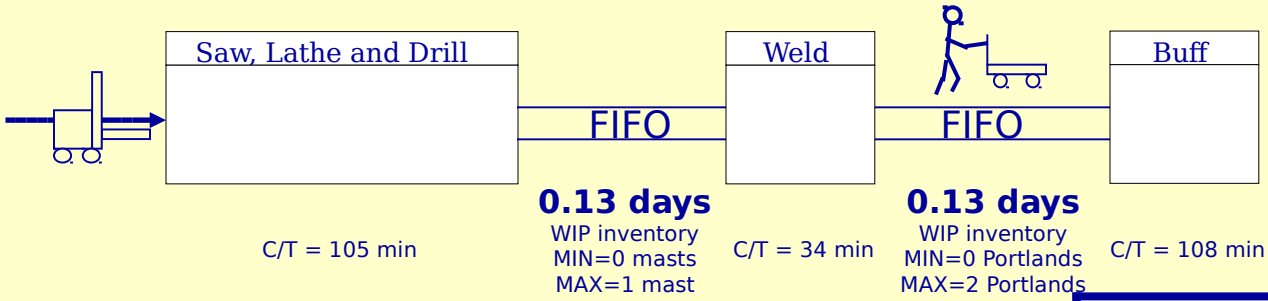
Mast Making Operation Before and After One-Week Lean Transformation: Will-Burt Co., Orrville, Ohio

BEFORE



Lead Time = 3.75 days

AFTER



Lead Time = 0.80 days

KEY:
WIP=Work-in-process inventory
C/T=cycle time of process
FIFO=first-in, first-out lane with controlled inventory

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Lean Process

From Fake Flow to One-Piece Flow in a Mast Making Process

	BEFORE	AFTER
PRODUCTION LEADTIME (DOCK TO DOCK)	37.8 days	29.2 days
PRODUCTION LEADTIME (SAW TO WELD)	3.75 days	0.8 days
# of FORKLIFT MOVES	11	2
TRAVEL DISTANCE (DOCK to DOCK per mast)	1792 ft	1032 ft
SHOP ORDER INPUT TIME (per mast)	207 min	13 min

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Benefits of Creating Flow

A. Quality:

Work is passed directly to next Process with

B. Productivity:

Minimize wasted movement,

C. Space

Free up floor space for new products

D. Lead Time: Shortest supply chain, highest flexibility to satisfy

E. Team Member Morale: Value of work is more visible & recognized ;

F. Cost:

Reduced Inventory Levels

Source: Toyota

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Tools to Create Flow

- Takt Time (build to pace of customer demand)
- Kanban (pull system)
- Sequenced Components
- First-in, First-out
- Leveled Schedules (heijunka)
- Value-Stream Mapping (lean vision)

Supported by:

- Built-in quality
- Total productive Maintenance
- Workplace organization (5S)
- Standardized work

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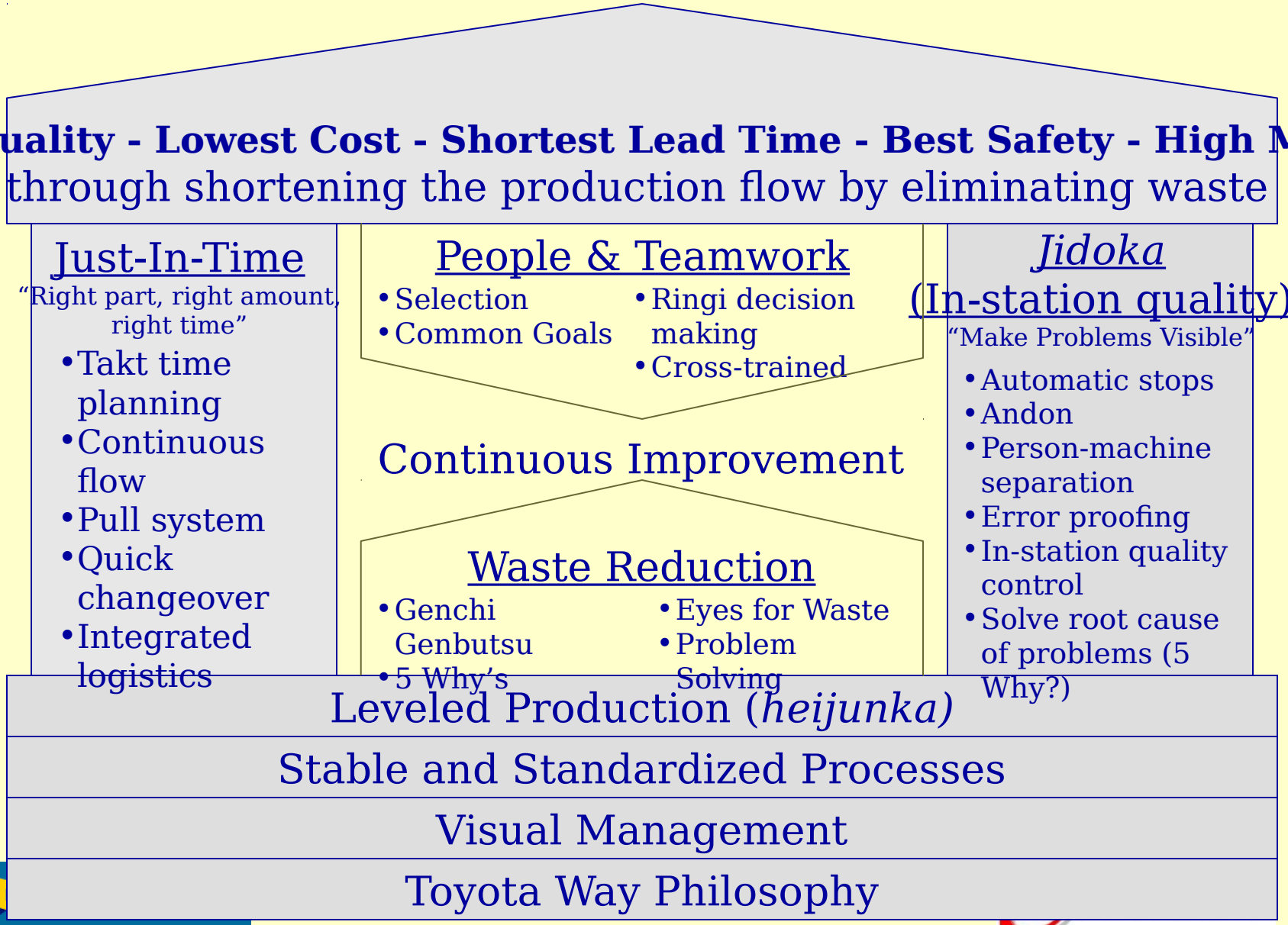
The Toyota Production System



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So What Happened at Will-Burt

- No follow-up
- Additional Lean Suggestions Not Taken
- Other Job-Shop Operations Not Improved
- Lean Process DOA

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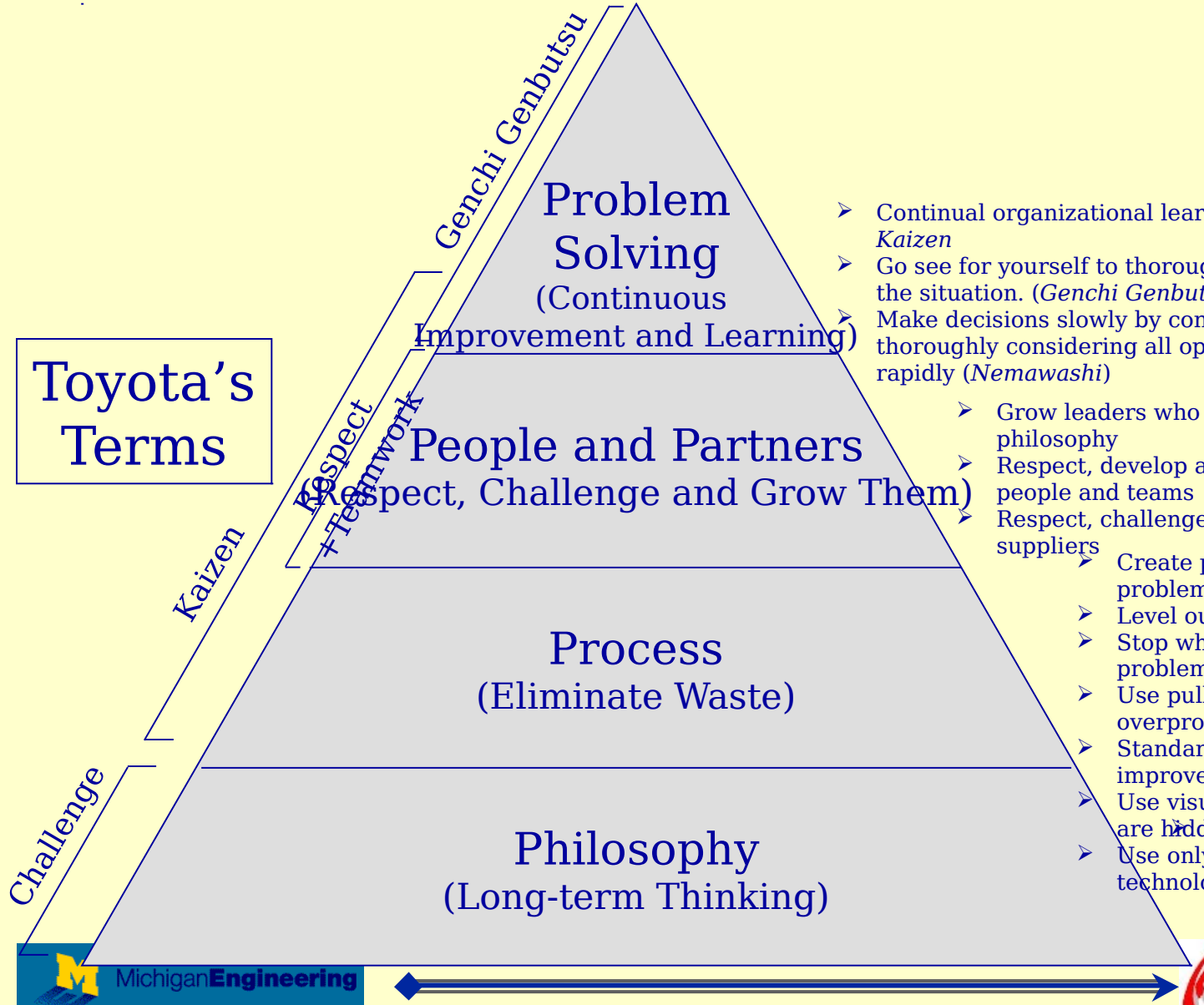
"4 P" Model of the Toyota Way



Toyota's Terms

- Continual organizational learning through *Kaizen*
- Go see for yourself to thoroughly understand the situation. (*Genchi Genbutsu*)
- Make decisions slowly by consensus, thoroughly considering all options; implement rapidly (*Nemawashi*)

- Grow leaders who live the philosophy
- Respect, develop and challenge your people and teams
- Respect, challenge, and help your suppliers

- Create process "flow" to surface problems
- Level out the workload (*Heijunka*)
- Stop when there is a quality problem (*Jidoka*)
- Use pull systems to avoid overproduction
- Standardize tasks for continuous improvement
- Use visual control so no problems are hidden
- Use only reliable, thoroughly tested technology

- Base management decisions on a long-term philosophy, even at the expense of short-term financial goals

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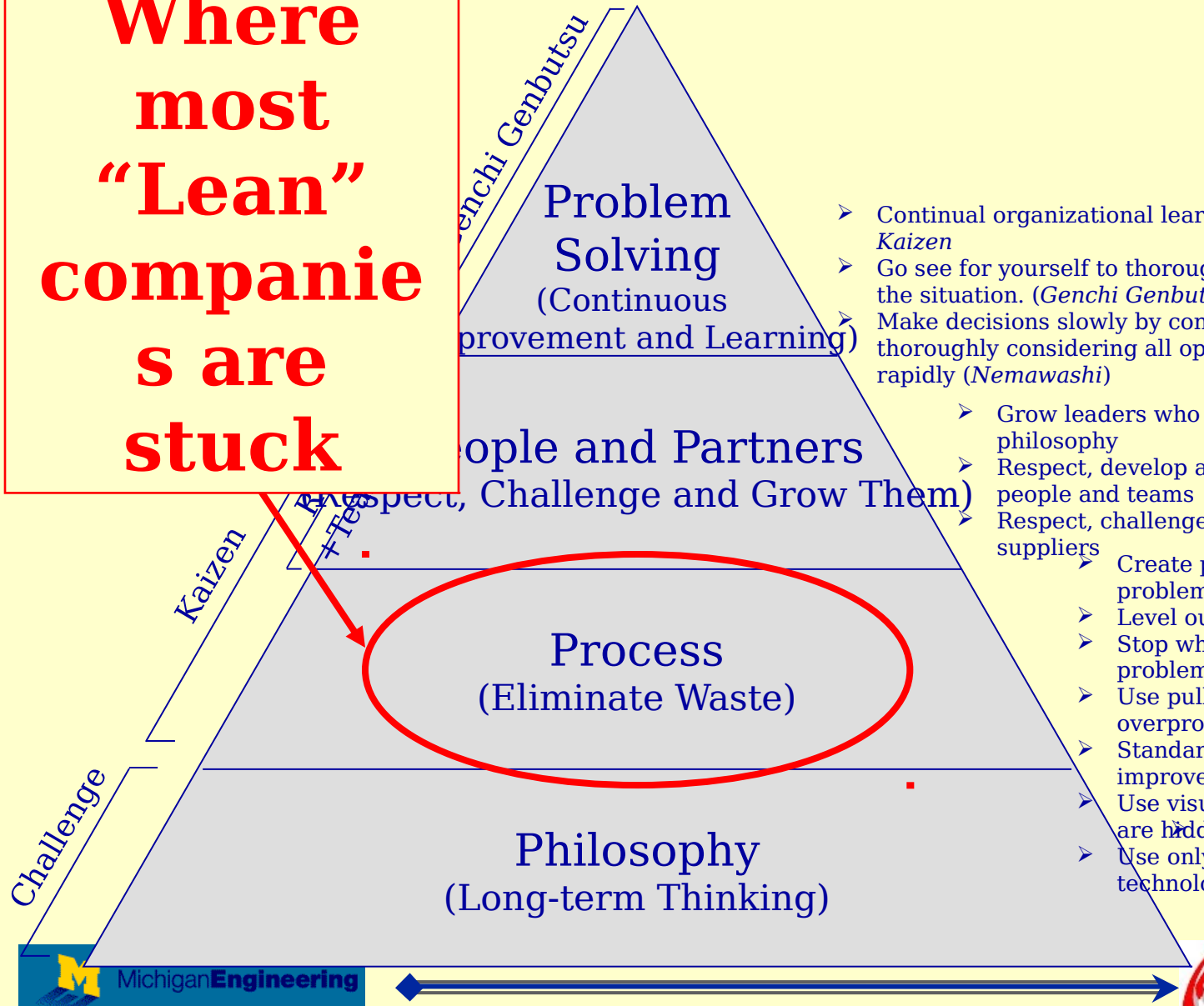
"4 P" Model of the Toyota Way

Where most "Lean" companies are stuck



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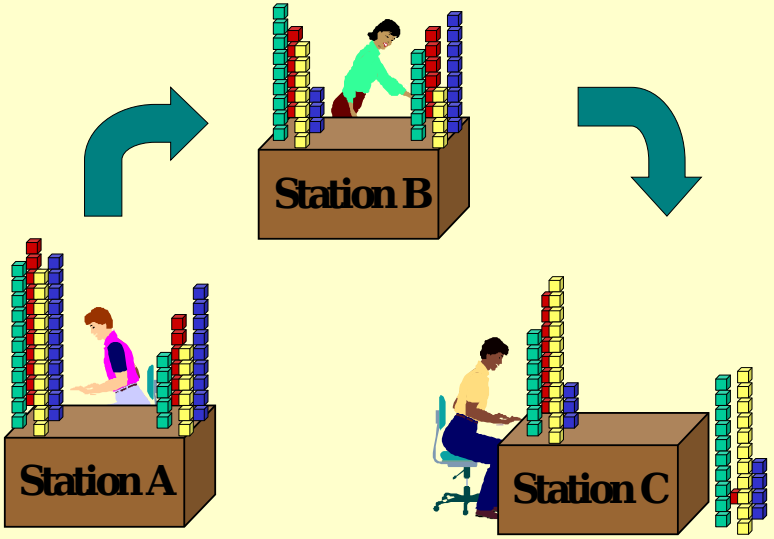
Teams and One-Piece Flow

Teams and Batch & Queue



Teams and Flow

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TPS is about Growing People

"Really understanding TPS is very difficult and generally speaking people talk about one piece—kanban, andon, poka yoke. That in my opinion is one piece of TPS and it is not the goal of TPS. Take the example of one piece manufacturing. If some problem occurs then you cannot produce goods through this system. If you just look at this segment of it, it is not a good way to produce things. So in one piece manufacturing, if something goes wrong you stop production so we have to think how to stop having that same problem twice and you have to really think and think. This is the part that is the real truth of TPS production. So team members have to think and through thinking team members grow and become better team members and people."

Terujuki Minoura
President, Toyota Motor Manufacturing, North America
March 12, 2002

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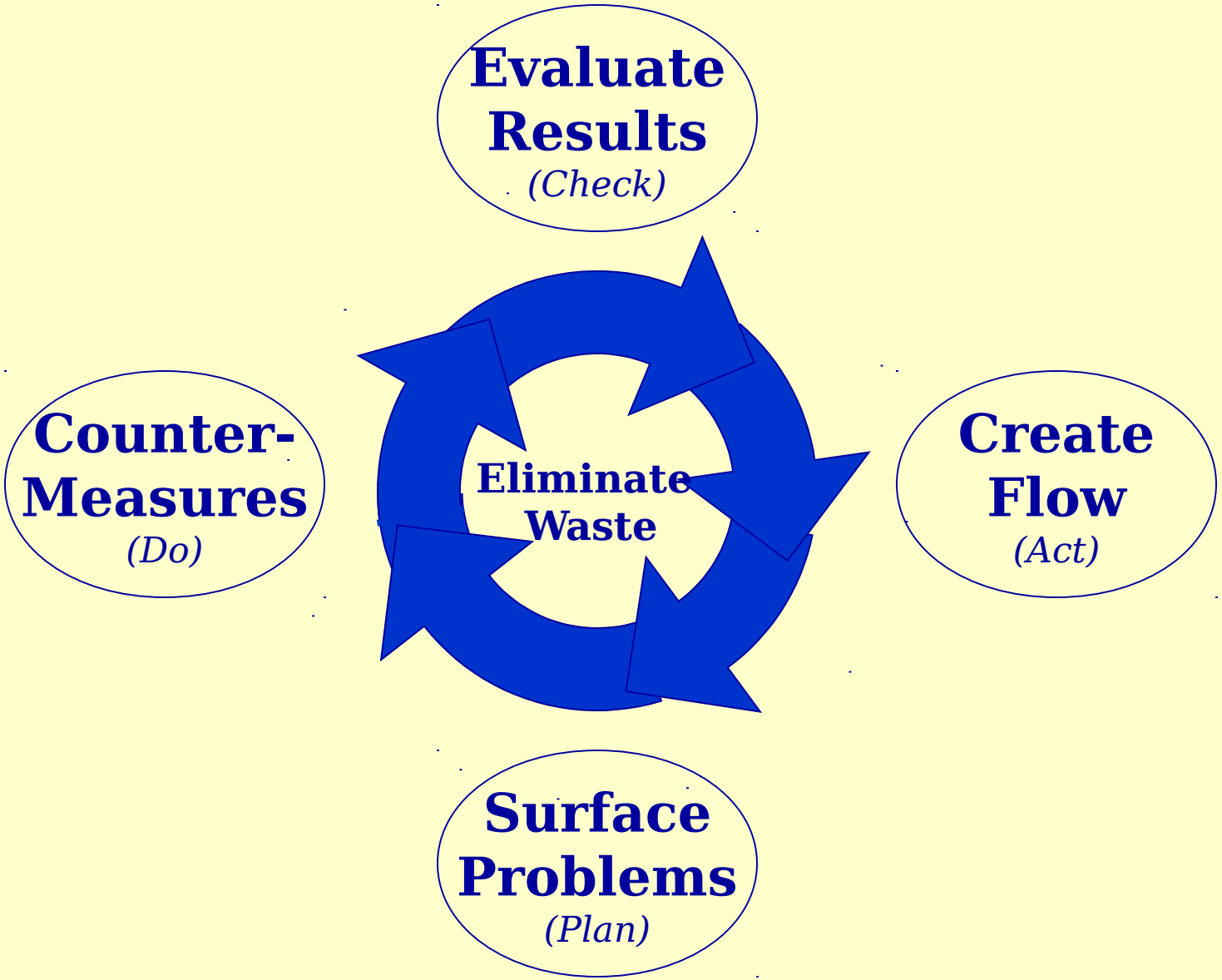
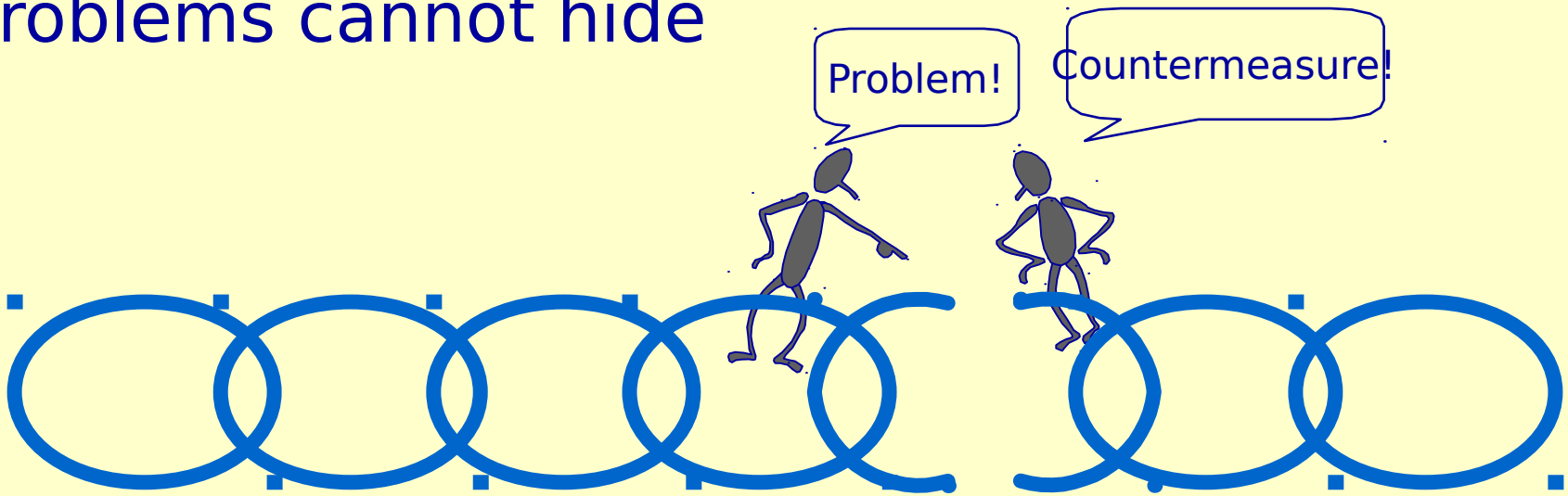
Why Flow?


Evaluate Results
(Check)
Counter-Measures
(Do)
Eliminate Waste
Create Flow
(Act)
Surface Problems
(Plan)

TPS FLOW ENVIRONMENT

Tightly linked processes

Problems cannot hide



Source: Glenn Uminger, Toyota Motor Manufacturing North America

Toyota Philosophy: The Foundation of Lean Thinking

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Company Foundation

Toyota Motor Manufacturing **MISSION**	Ford Motor Company **MISSION**
1. Add value to customers and society 2. As an American company contribute to the economic growth of the community and the United States 3. As an independent company, contribute to the stability and well-being of team members 4. As a Toyota group company, contribute to the overall growth of Toyota	Ford is a worldwide leader in automotive and automotive-related products and services as well as in newer industries such as aerospace, communications, and financial services. Our mission is to improve continually our products and services to meet our customer's needs, allowing us to prosper as a business and to provide a reasonable return to our stockholders, the owners of our business.

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Examples of Respect for Humanity

NUMMI:

- Brought in old union shop committee despite GM recommending against,
- 25% downturn in sales and no layoffs.

TABC

- Moving truck bed manufacture from California to Mexico. No layoffs. "**People in Japan felt they did a good job with limited resources and we are not going to penalize them for another business decision. When asking team members to give 100% and improve productivity and quality. What do they get in return if you thrown them out on the street. That is the Toyota system. It goes back to stakeholders.**"

Toyota, Georgetown Plant

- One house was on property Toyota had purchased for the plant and the owner complained about Toyota destroying the house. This went up to the President's level and he ordered the house to be moved at Toyota's expense and the owner compensated. Zero tolerance policy for community disruption.

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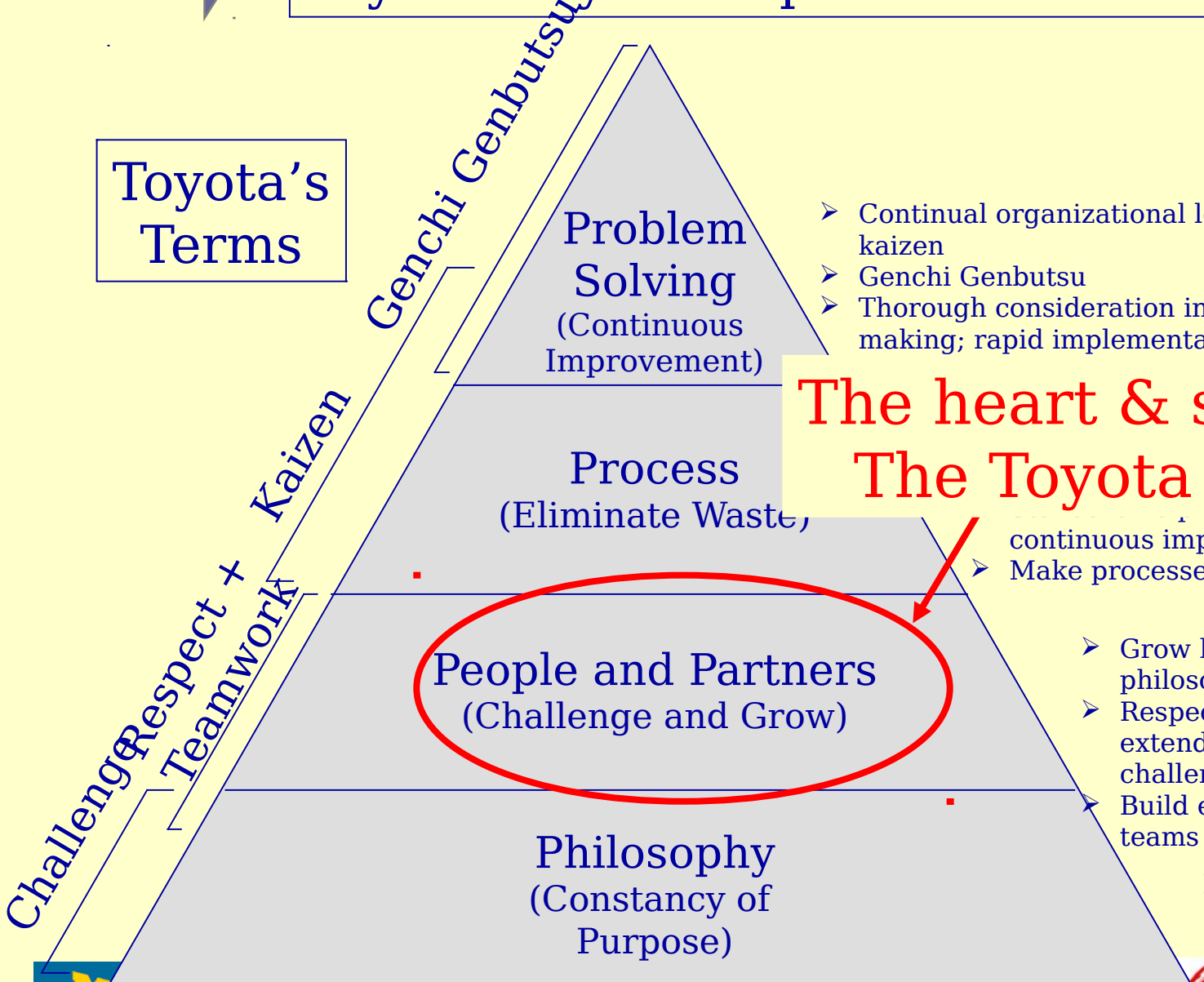
Toyota Way Principles in 4P Model

Toyota's Terms



- Continual organizational learning with kaizen
- Genchi Genbutsu
- Thorough consideration in decision making; rapid implementation

The heart & soul of The Toyota Way

- ns
- roblem
- parts

- continuous improvement
- Make processes visual

- Grow leaders who live the philosophy
- Respect your people and extended network through challenge
- Build exceptional individuals + teams

- Base management decisions on a long-term philosophy

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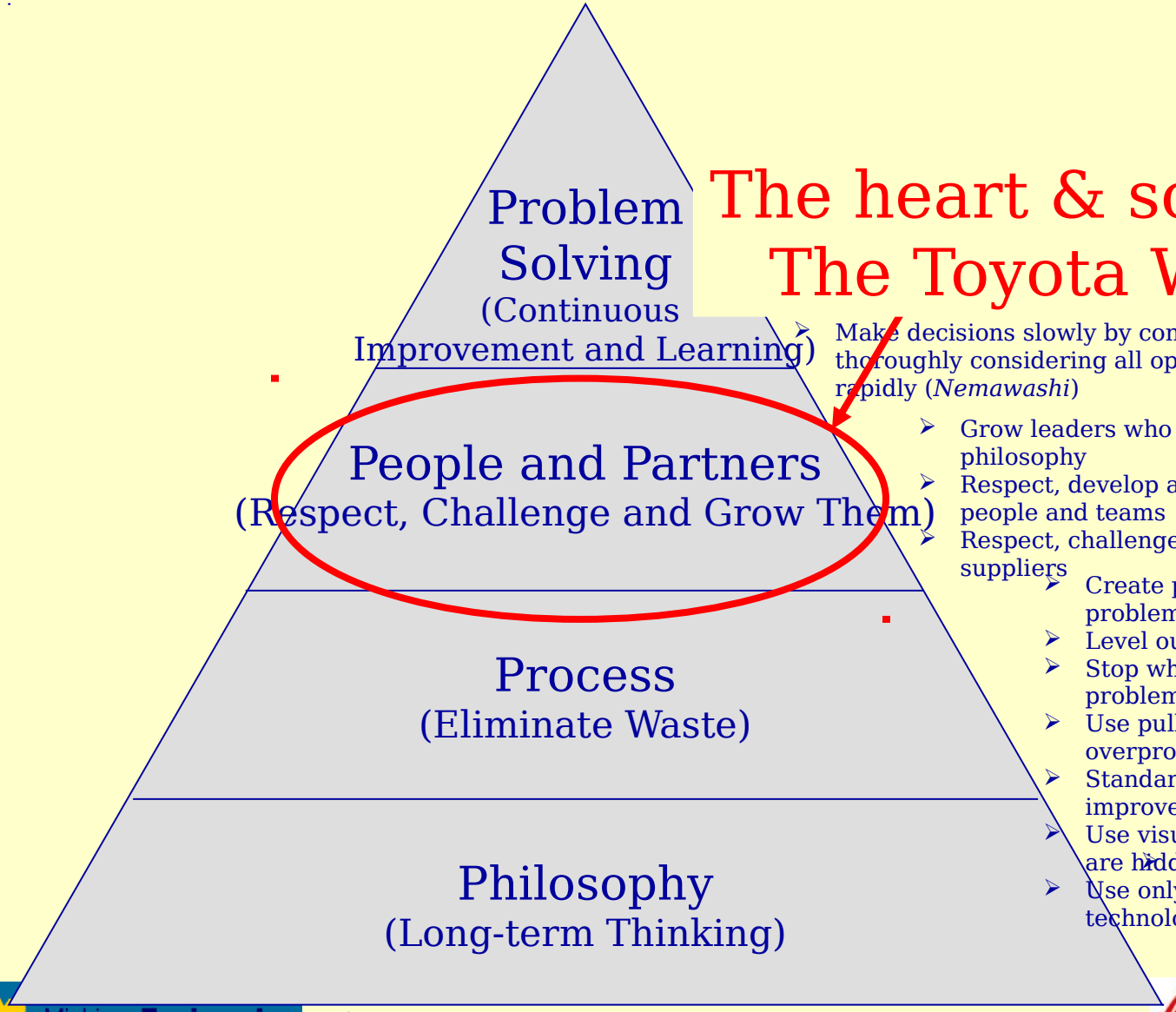
"4 P" Model of the Toyota Way



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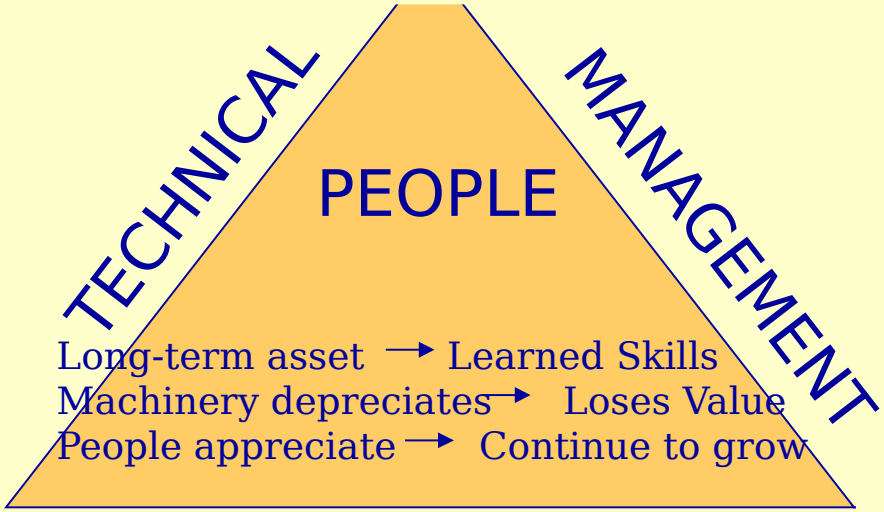
People and Partners

Develop Exceptional Associates and Teams who follow the Toyota Way
Challenge the Extended Network of Partners to Grow
Develop Leaders who Live the Philosophy
Continuously Develop People

A Toyota Leader's View of the Toyota Production System

Toyota Production System=Operations Management System to achieve goals of highest quality, lowest cost, shortest lead time via engaging people toward goals.



Technical
- Stability
- JIT
- Jidoka
- Kaizen
- Heijunka

Management
- True North
- Tools to focus management attention
- Go & See
- Problem-solving
- Presentation skills
- Project
  ement
  ortive

Philosophy/Basic Thinking
- Customer First
- People are most important asset
- Kaizen
- Go & See → Focus on Floor
  - Give feedback to team members and earn respect
- Effciency Thinking
  - True (vs. apparent) condition
  - Total (vs. individual) team involvement

Source: Gary Convis, President of TMMK

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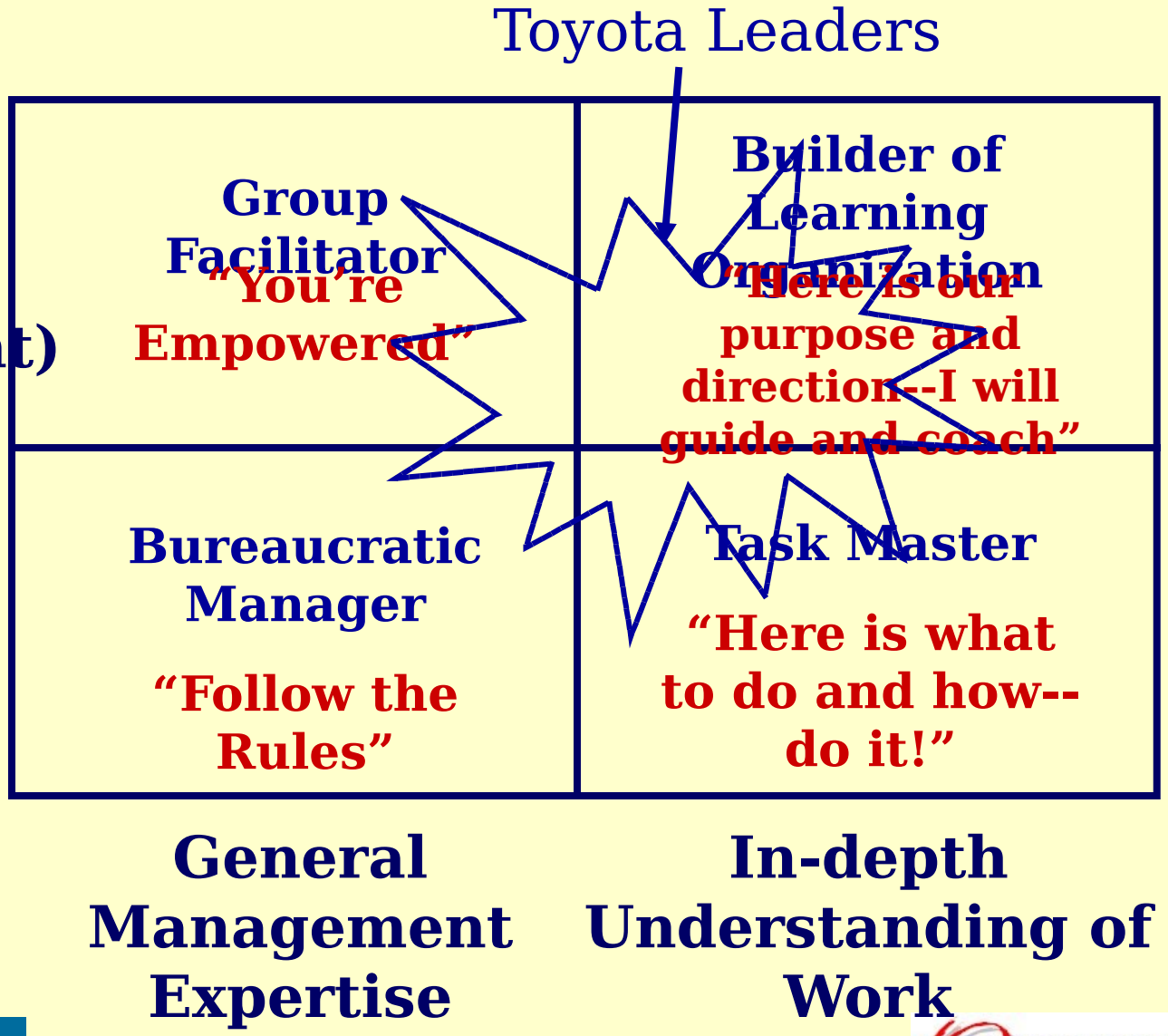
Toyota Leadership Model



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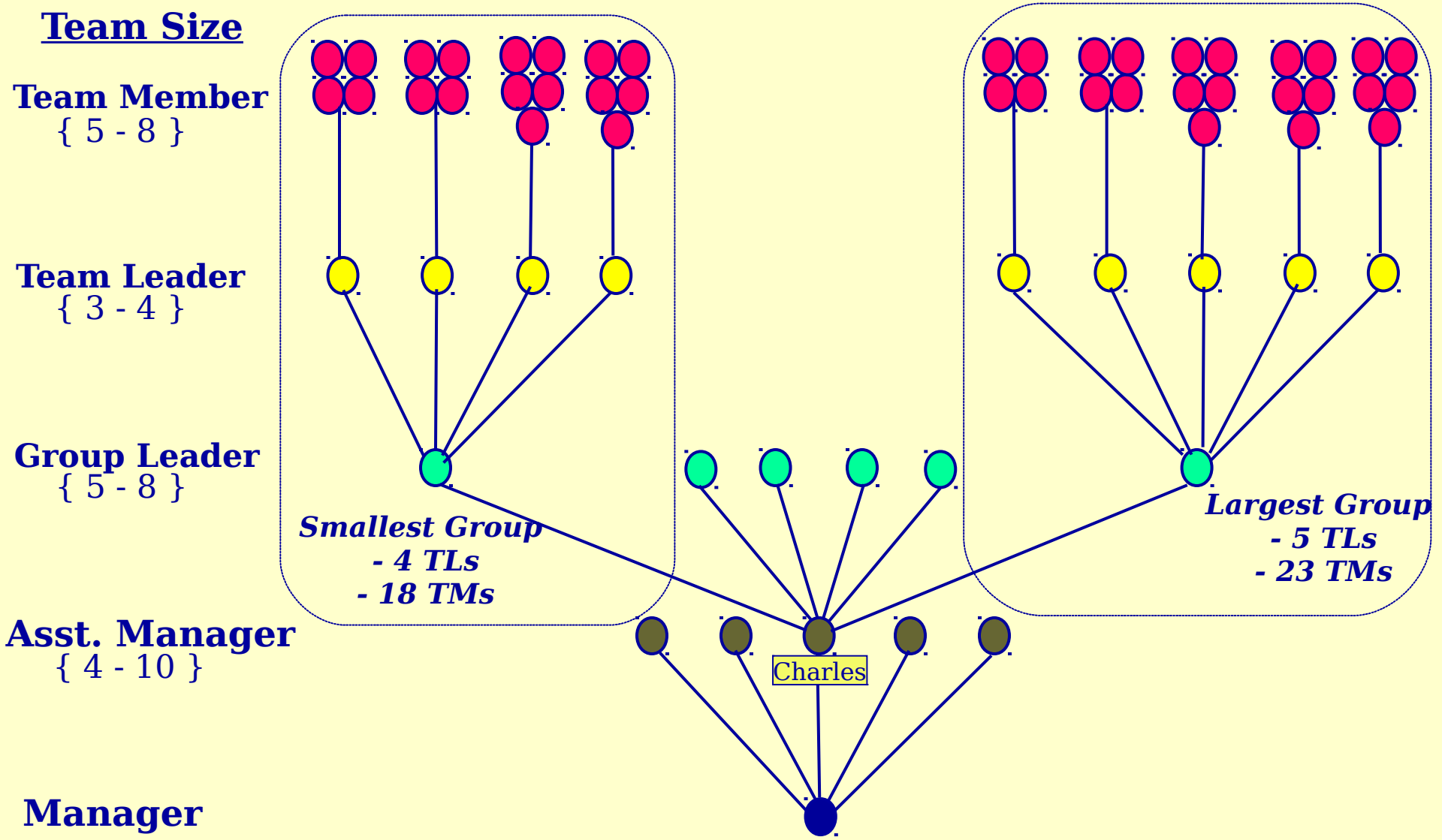
Typical Toyota Organization- Assembly Operation

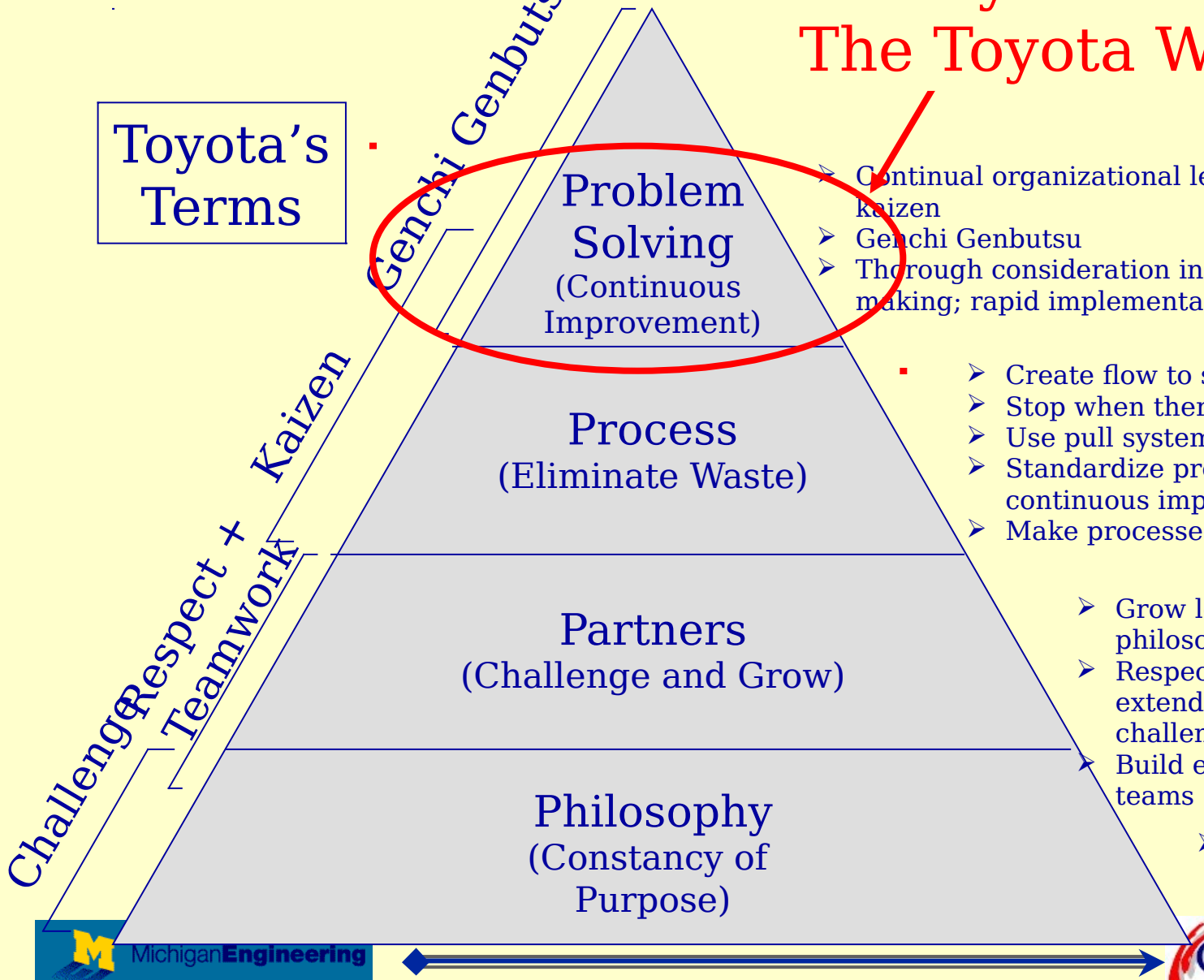


Source: Bill Costantino, former group leader, Toyota, Georgetown

Toyota Way Princi

The dynamic of The Toyota Way

Toyota's Terms



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Genchi Genbutsu

- The Ohno Circle--Stand in the circle and observe
- Gary Convis--President moves to shop floor
- Sienna Chief Engineer--”I must drive through all 50 states and all Canadian provinces and territories and Mexico”
- Engineering--Go and see where the actual parts are made and tested

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Thorough Consideration in Decision Making

- Arizona Proving Grounds
- Purchased 12,000 Acres of Douglas Ranch in 1989
- Lawyer: Dick Mallery--Phoenix man of year, 40 years

> "I came away with a far more complete knowledge of the legal history of Arizona and the development of its statutory and common law than I ever had before (laughing) because I had to answer all of the Toyota team's questions. I could not just point to the title policy and say either that is how we have always done it or do not worry, the seller will indemnify us. The Toyota team wanted to dig deeper. Toyota still wanted to know the complete background and history leading up to the decision that Toyota had to make. I became a student again and learned a lot about the federal system that established Arizona first as a territory and then as a state.

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Example A3 Report

To: Jim Griffith, VP ATM
Joe Fukunaga, CFO
Date: August 20, 1996

PURCHASING CARD IMPLEMENTATION

CURRENT SITUATION

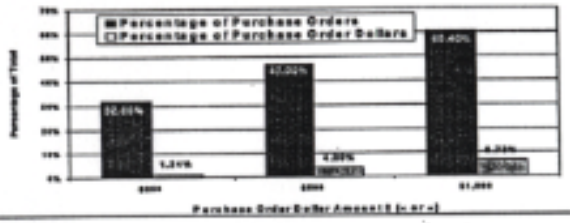
Cost to process PO (labor & mat'l):
Purch. Dept.- $57.00 AFD - $39.00 Tech. Dept. - $27.00 TOTAL = $103.00/PO

Cost to process Invoice (labor & mat'l):
Purch. Dept.- $0.00 AFD - $27.00 Tech. Dept. - $27.00 TOTAL = $54.00/Invoice

1995

# of Purchases:	<= $250.00 - 813	<= $500.00 - 1200	<= $1,000.00 - 1525
# of Invoices:	<= $250.00 - 2516	<= $500.00 - 2740	<= $1,000.00 - 3026
Time Required:	<= $250.00 - 5525 Hrs.	<= $500.00 - 7184 Hrs.	<= $1,000.00 - 8489 Hrs.

TTC Purchase Order Analysis



PROPOSAL

Implement use of purchasing credit cards for purchases < = $500.00 to incur the following savings and increases in efficiency:

- -Labor hours saved - Tech Groups, Purchasing, AFD
- -Labor & Material Cost savings.
- -Reduced P.O., RFP, Expense Reports, Invoice paperwork.
- -Customer Service to T/A's through reduction of time spent on completion of paperwork.
- -Ease of performing spot transactions - Test Trips, Emergency Purchases, Etc.
- -Helps to maintain existing ADM & AFD headcount while TTC grows over next 5-10 years.
- -Reallocated time used on higher ticket buys, priority projects, etc.

LABOR COST & TIME ANALYSIS

LABOR & MAT'L SAVINGS:

	P.O.	INV.
Current Cost/Transaction	$103.00	$54.00
Purchasing Card Costs	$20.00	$20.00
Savings/Transaction	$83.00	$34.00

TIME SAVINGS:

	P.O.	INV.
Current process:	3300 Hrs	3900 Hrs
Purchasing Card:	650 Hrs	1550 Hrs
Potential Annual Time Savings	2650 Hr/Yr*	2350 Hr/Yr*

*Approx. 1/3 of time savings is to Tech Grps.

PLAN

-Pilot program starting with Facilities, Purchasing, Tech. Grp. (AA-PED; LA-LAPT; TAPC-VEA)
-Dept. GM determines which T/A's are issued cards for specific dept. purchases.
-Purchasing is issued cards .
-Acceptable business related purchases using card:

Small Tools	Seminars	Photo Processing & Film
Auto Supplies	Office Supplies	Postage
Minor Equip. Repairs	Printing Services	Copy Services
Electrical Supplies	Safety Supplies	Bldg. Maint. Supplies
Catering	Florists	Coffee Services
Hardware	Signage	

-Unacceptable uses of card (blocked)

Cash Advance	Travel & Entertainment	Independent Contract Services
Computer Hardware	Personal Use	Capital Purchases
Jewelry, Furriers		

IMPLEMENTATION

1. Card user obtains approval from Dept. Manager for each purchase.
2. Card user contacts vendor, places order & provides vendor with appropriate information.
3. Goods shipped as specified and labeled "Purchasing Card" - Cardholder Name.
4. Goods received per standard receiving procedure with following exception: packing list & receipt is forwarded to card user.
5. All packing lists & receipts are retained by requestors and matched against monthly statement.
6. Card user reviews statement, attaches appropriate packing lists & receipts, records JRN #'s, signs and forwards to Dept. Manager.
7. Dept. Manager reviews statement for accuracy and initials and dates statement.
8. Dept. Manager forwards to AFD. AFD audits statement & supporting docs. for compliance, sales tax, 1099.
9. AFD pays from master invoice received directly from the purchasing card bank.

CONTROLS

The following controls are set up prior to the card being issued:

- Monthly dollar limits per card
- Single transaction limits ($500.00)
- Limited number of transactions per card per day
- Merchant Category Blocking (i.e. cash advances, jewelry stores, appliances, entertainment, etc.)

TTC requires all card users to sign a P-Card Agreement stating that all use of the card will be for business purposes and within the procedures set forth.

TIME LINE

9/3	9/4-9/20	9/16-11/15	11/18-5/31	11/18-5/31	4/1-4/15	4/16-4/18	4/21-5/30	6/2/97
Present at CP Mtg.	Policy Guidelines, Issuer Selection & Supplier Enrollment	Training for Pilot Program - Purch/AFD, Management, Cardholders	Pilot Program	Concurrent Revisioning of Policy & Procedure	Audit & Analyze 5 Month Pilot Program	Report Results of Audit	Training - Corporate Wide	Corporate Wide Implementation

Use PDCA in Problem Solving and Decision Making

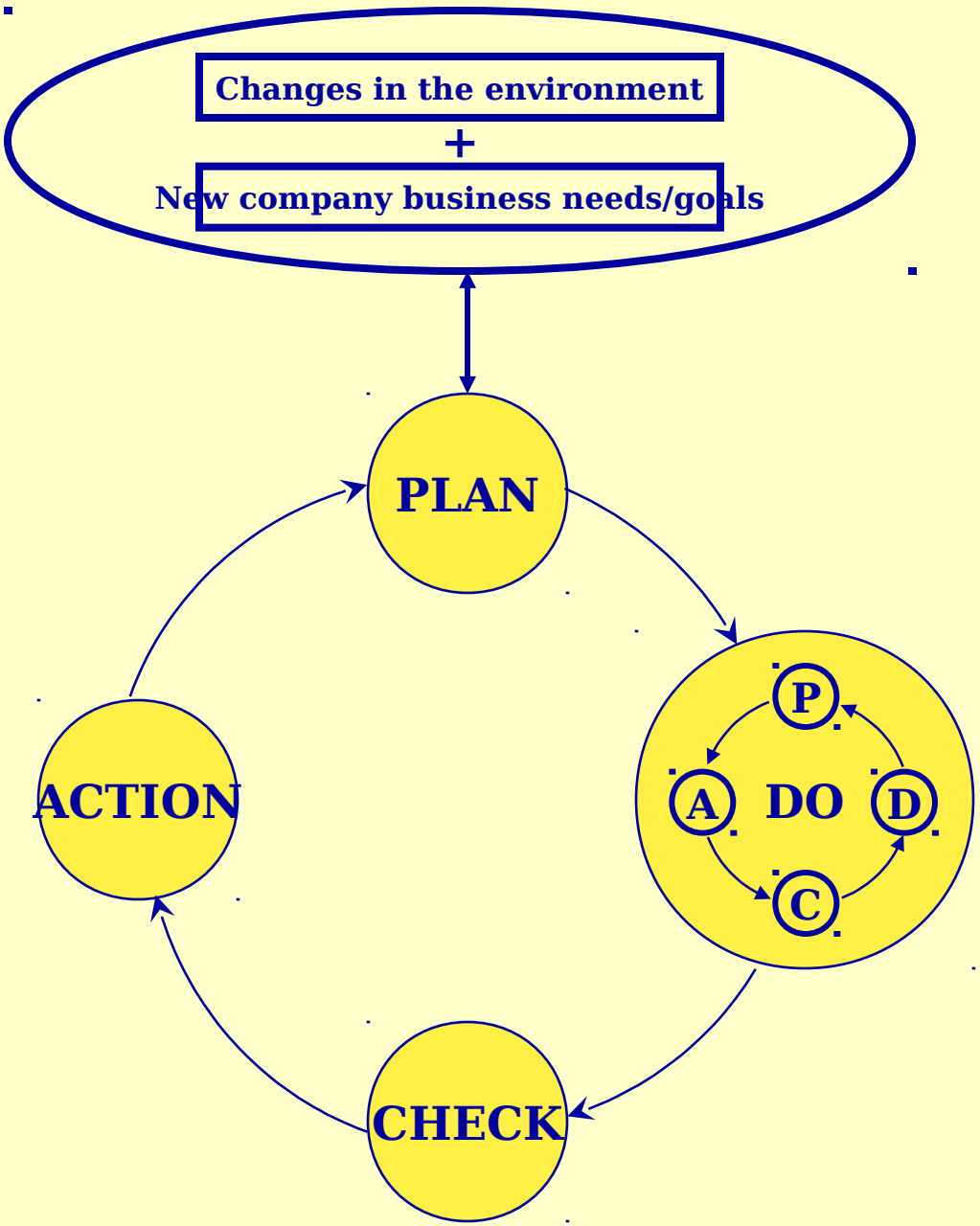
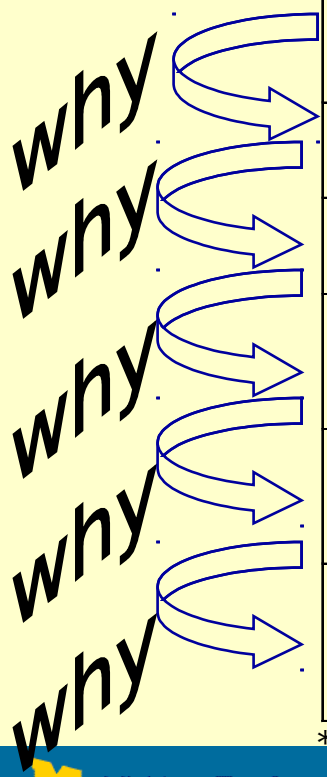


Figure 17.1: "5 Why" Cause Investigation Questions

5 Whys is a method to pursue the deeper, systematic causes and eventually a corresponding deeper countermeasure.



Level of a problem	Corresponding level of countermeasure
There is a puddle of oil on the shop floor	Clean up the oil
Because the machine is leaking oil	Fix the machine
Because the gasket has deteriorated	Replace the gasket
Because we bought gaskets made of inferior material	Change gasket specifications
Because we got a good deal (price) on those gaskets	Change purchasing policies
Because the purchasing agent gets evaluated on short term cost savings	Change the evaluation policy for purchasing agents

* Peter Schodes, The Leaders' Handbook, Toyota Motor Company

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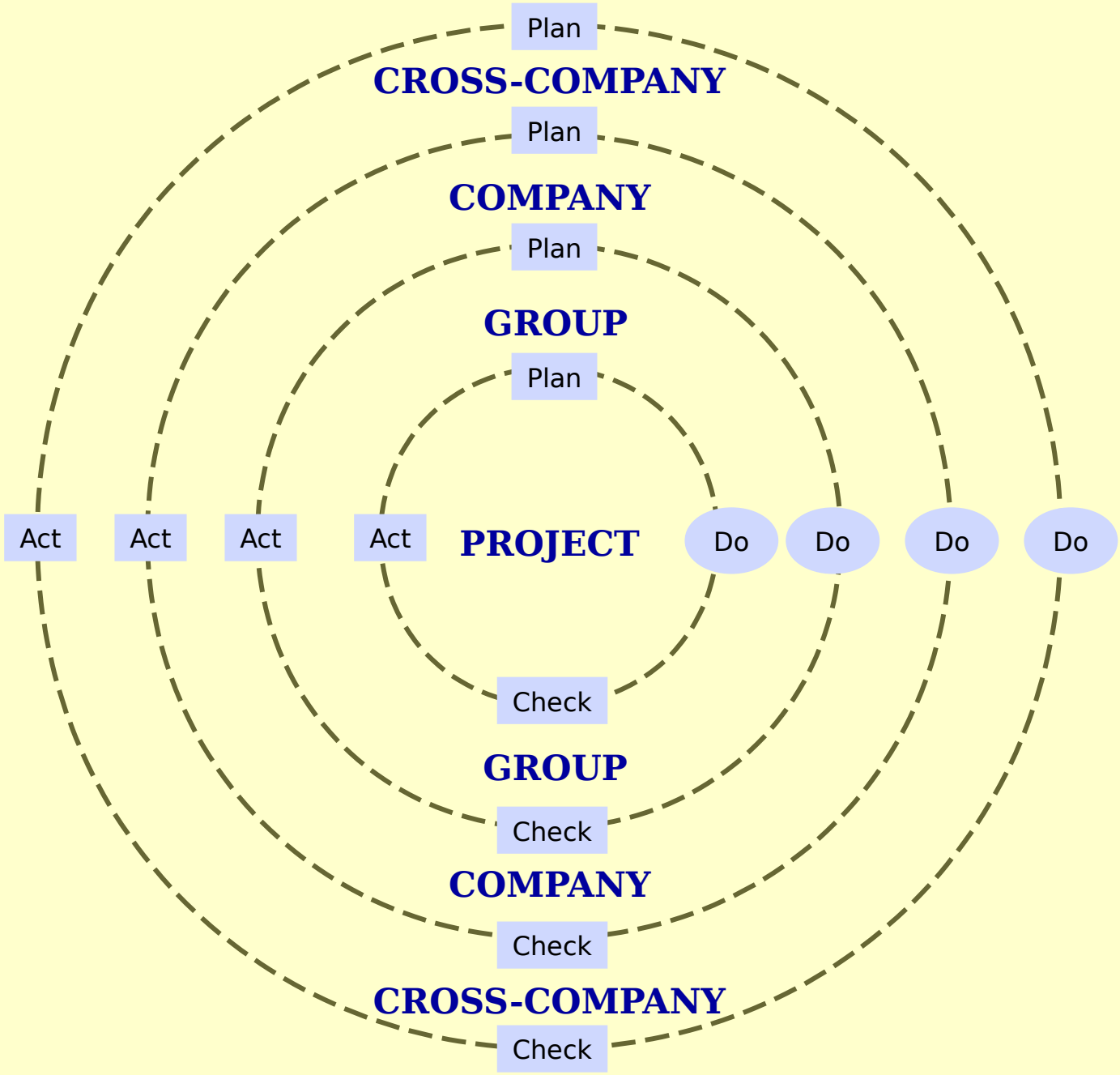
The Deming Cycle at all Levels of the Enterprise



What has Toyota Done?

- Created some neat and powerful tools
- Helped us to see the value of flow through the value stream

But more significant:

- Created true learning organization at an extended enterprise level.
- Built a strong culture of problem solving, decision making, respect for humanity at every level in organization.
- Passed on the strong culture through growth to a large, multinational bureaucracy.

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What can we learn from Toyota?

- Neat and powerful tools
- Understand how to see flow and waste in our value streams

But more significant:

- Must go beyond programs to processes
- Must develop a stable, long-term philosophy engrained in the DNA of top management
- Must invest in our people--technical skills, teaming skills, and way of approaching problems
- Must develop our own culture
- Many steps on way to learning enterprise.

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Strategies for Implementing Lean

Hot Projects	Over-all System	Plant-Wide Tools	Value Stream Focus

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Lean Strategy : ***Hot Projects***

Characteristics

- Short-term urgency : solve current crisis
- 1-dimensional

PROS

- High interest / support
- Resources usually available
- Bias for action
- Willingness to make radical changes quickly
- Opportunity to convince skeptics

CONS

- No overall vision / strategy
- No system to support lasting change
- High probability of back-sliding
- Prone to “Band-aids” rather than root cause solutions
- Lacks ownership

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Lean Strategy : ***Overall System***

Characteristics

- Focus on education & training
- Understanding & Buy-in
- Convincing upper mgmt.
- Typically large, multi-plant organizations
- Staff-centered deployment
- Everyone advances together
- Focus on right measurements

PROS

- Lots of opportunity for buy-in
- Consistent message across entire organization

CONS

- VERY SLOW Progress
- $$ Expensive $$
- Invites lots of useless debate, resistance
- Often feels overwhelming, leads to stalls
- Bias is toward Power Point presentations rather than action.

Lean Strategy : ***Plant-wide Tools***

Characteristics

- Install 1 Lean Tool Plant-wide
- Narrow focus
- "Cookie cutter" implementation
- Wall-to-wall all areas

PROS

- Strengthens foundation for further lean development
- Creates common language
- Creates organizational focus
- Can address core problems
- System for implementing matures quickly
- Quick implementation of the chosen tool
- Little resistance - small pieces

CONS

- Tool may not be a priority in certain areas
- System for long-term support often over-looked
- Lop-sided effort, overall system not balanced
- Buy-in often difficult

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Strategy : ***Value Stream Improve***

Characteristics

- "Learning to See" method
- Current & Future State maps
- Select focus activities
- Project management approach

PROS

- Efforts are well-integrated within a larger view
- Multiple benefits to value stream are common
- Results typically well-quantified and tangible

CONS

- Can be time consuming
- Fluff - if no follow-up
- Requires large involvement to be effective
- Wide variability in execution
- Can be difficult to identify value streams

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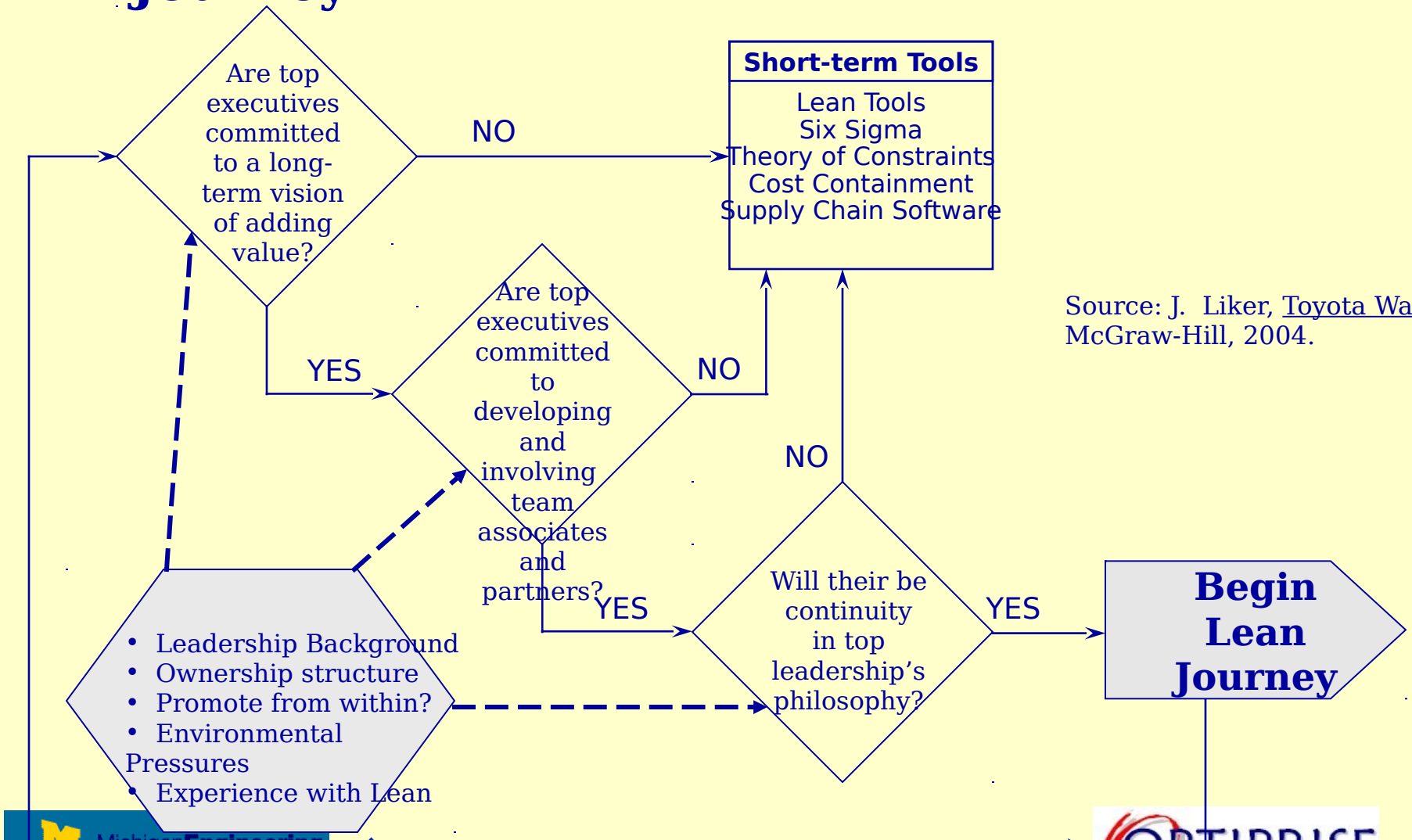
Top Leadership Commitment to Lean Journey



Source: J. Liker, Toyota Way, McGraw-Hill, 2004.

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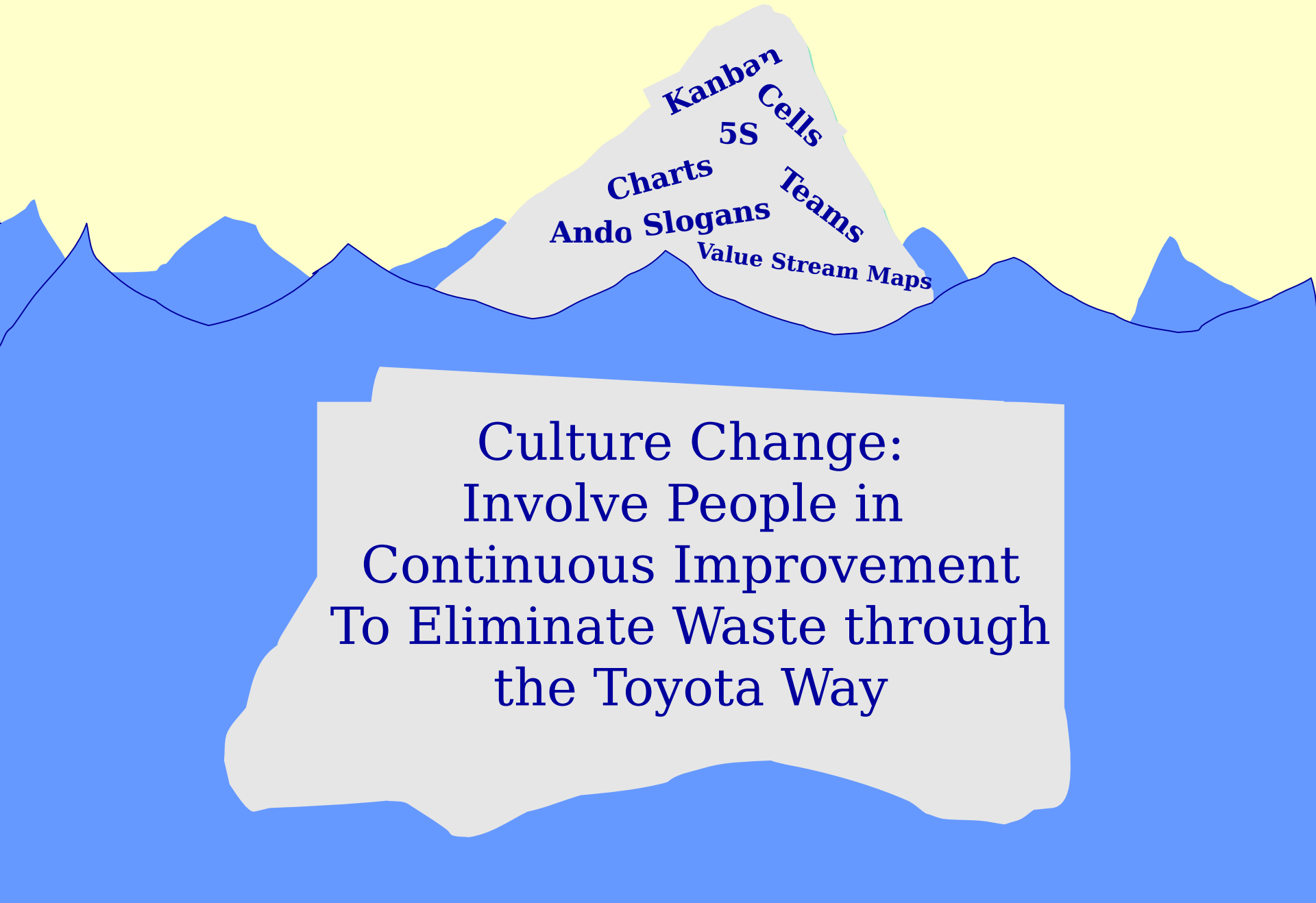
Myth versus Reality of the Toyota Production System

Myth What TPS Is Not	Reality What TPS Is
A Tangible Recipe for Success	A Consistent Way of Thinking
A Management Project or Program	A Total Management Philosophy
A Set of Tools for Implementation	Focus on Total Customer Satisfaction
A System for Production Floor Only	An Environment of Teamwork and Improvement
Implementable in a Short or Mid-term Period	A Never Ending Search for a Better Way
	Quality Built in Process
	Organized, Disciplined Workplace
	Evolutionary

Source: Glenn Uminger, Toyota Motor Manufacturing North America

Iceberg Model of TPS



Build Your Own Lean System Learning from the Toyota Way

- *Start with action in the technical system, follow quickly with cultural change*
- *Learn by doing first and training second*
- *Start with value stream pilots to demonstrate Lean as a system and provide a "go see" model*
- *Use value stream mapping to develop future state visions and help "learn to see."*
- *Use kaizen workshops to teach and make rapid changes*
- *Organize around value streams*

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Build Your Own Lean System Learning from the Toyota Way (cont.)

- *Make it mandatory*
- *A crisis may prompt a Lean movement, but may not be necessary to turn a company around*
- *Be opportunistic in identifying opportunities for big financial impacts*
- *Build on your company's roots to develop your own way*
- *Hire or develop Lean leaders and develop a succession system*
- *Use experts for teaching and getting quick results*

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